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Geological Light on the Interpretation of "The Tongue" in Joshua 15^{2, 5} 18¹⁹

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IN Josh. 15 2, etc., we read that the south border of Judah "was from the uttermost part of the Salt Sea, from the bay (*lašôn*) that looketh southward." In vv. 5 f. we read that "the border of the north quarter was from the bay (*lašôn*) of the sea at the end of the Jordan, and the border went up to Beth-Hoglah, and passed along by the north of Beth-arabah." Again in describing the border of Benjamin (Josh. 18 19) we read that "the border passed along to the side of Beth-Hoglah northward, and the goings out of the border were at the north bay (*lašôn*) of the Salt Sea, at the south end of the Jordan." But at the present day there is nothing like a bay or "tongue" at either end of the Salt Sea, while Beth-Hoglah is several miles above the present mouth of the Jordan.

In the *Recueil d'archéologie orientale* (vol. v, 1902, p. 267-280) M. Clermont-Ganneau endeavors to clear up the difficulty by supposing that in the time of Joshua the level of the Dead Sea was so much higher than now that a tongue of water extended northward as far as Beth-Hoglah. He calls attention to the very awkward turn which the border of Benjamin is compelled to make to reach the Salt Sea if the configuration of the land was then as it is now, and to the fact that the northern border of Judah from the end of the sea through the valley of Achor to Jerusalem is nearly straight, while it is the rule that where a sudden change of direction in the boundary is made the fact is clearly indicated. This makes it improbable that the boundary turned sharply to the south as it has to do now to fit the conditions.

There can be little doubt, therefore, that Clermont-Ganneau is correct in his main contention as to a change of level. But careful attention to the geological forces at work in the region furnishes an explanation the very opposite of that urged by him. For it is plain that the Jordan is constantly pushing out a delta into the head of the Salt Sea, and thereby limiting the area of evaporation so as to raise its level and compel it to overflow the lowlands at the south until equilibrium is again established. The tongue, spoken of in Joshua as at the north end of the lake, extended up the present valley of the Jordan as far as Beth-Hoglah at a lower level, thus conforming accurately to the description. The subject is so interesting that it will be profitable to enter into the details with considerable minuteness.

The Salt Sea as it exists at the present time is but a small remnant of the body of water which at one time filled the whole Arabah from the Waters of Merom to the Springs of Abu Werideh forty miles south of the Salt Sea. At these springs there are, according to Hull (*Mount Seir*, etc., p. 99 ff.), extensive soft sedimentary deposits marking an abandoned shore line, containing shells of the same species of mollusks that inhabit the lagoons about the Salt Sea now at its lower level. The elevation is here 1400 feet above the Salt Sea, and shore lines of the same deposits are reported by Mr. Ellsworth Huntington¹ at various points all around the southern part of the basin. Thus there can be no doubt that a body of water filled the whole depression of the valley of the Jordan to that height, producing a lake about 200 miles long and thirty miles wide with a depth of 2700 feet in its deepest part.

Other abandoned shore lines have long been noticed, the most prominent of which is that at a level of 650 feet above the lake. Mr. Huntington informs me that he has detected abandoned shore lines of marked size around the lake at the following levels above it; 1430, 640, 430, 300, and 230 feet, with lower strands at 210, 170, 145, 115, 90, 70, 56, 40, 30,

¹ The facts furnished by Mr. Huntington will be found in his forthcoming volume *Palestine and its Transformation*.

and 12 feet successively, while date palms and tamarisks standing in the water show that the level about 1870 was eight feet lower than now. These facts indicate that while there have been numerous minor variations in the climatic conditions of the region, there has been a gradual desiccation of the whole drainage basin throughout recent geological times. The progress recently made in our knowledge of glacial geology affords us a good deal of light upon the progress of events indicated by these abandoned shore lines. We have in the glacial epoch a cause amply sufficient to account for all these variations of level in the body of water occupying the valley of the Jordan (Arabah).

Since the elevation of the highest shore line of 1400 feet falls 200 feet below the height of the watershed in the Arabah south of the Salt Sea, and 150 feet below that between the valley of Esdraelon and that of the Jordan, it is clear that these levels have been determined throughout by the equilibrium that has been established from time to time between the precipitation and the evaporation over the whole drainage basin. The former prevalence of the precipitation over the evaporation can be positively connected with the prevalence of glacial conditions over the northern part of the Northern Hemisphere, extending as far south as the Lebanon Mountains. It is not known, however, that any glaciers formed within the area of the Jordan Valley itself. So far as we know Mt. Hermon never supported any glaciers, while the only glacier in the Lebanon Mountains was that which occupied the head of the valley of the Kādisha River, and which deposited the enormous terminal moraine on which the principal grove of the cedars of Lebanon is growing. This glacier, starting from the highest summit of Lebanon, 10,000 feet above the sea, descended through the valley of the Kādisha a distance of about ten miles where it reached the level of 5000 feet, and built up a moraine nearly 1000 feet thick at its front end, and stretching across the whole width of the valley, a distance of several miles. This glacier represents the climax of the Glacial epoch, corresponding to that in Europe, when the Scandinavian ice ex-

tended to the border of the mountains 100 miles south of Berlin, and as far as Kiev in Southern Russia, and when in America the ice extended to Staten Island in New York, and as far south as Cincinnati, in Ohio, Carbondale, in Illinois, and Topeka, in Kansas. In all these regions the semiglacial conditions extended a considerable distance farther south, producing increased precipitation and diminishing evaporation. There can be no doubt that the highest abandoned shore lines around the Dead Sea mark the rise of water there during the climax of the Great Ice Age. Furthermore, the several major abandoned strands around the Arabah correspond so closely to the various episodes of retreat and advance of the continental glaciers in Europe and America, that it is not easy to doubt that they form part of the record of the various abnormal movements in the crust of the earth which occurred between the Tertiary and the Recent geological periods.

These cycles of geological movement had, however, practically come to a close before history opens in the valley of the Jordan. The area of the Dead Sea had come down so nearly to its present dimensions before the time of Abraham and Chedorlaomer that we may consider the conditions as practically constant from that time on to the present. But the glacial lake which filled the valley left a sedimentary deposit of great depth (more than 100 feet), over all the lower part of the Jordan Valley, such as is left in the bed of a mill pond when the water is drawn off. It is through this sedimentary bed that the present river winds its way in the narrow channel called the Zôr, approximately 100 feet below the general level of the soil.

This brings us to the practical question which we have set out to solve. All the material which filled the cavity of the Zôr, approximately 60 miles long, one half mile wide, and 100 feet deep, has been cut out by the river and transported to the head of the Dead Sea, where it has been deposited as a delta, thus encroaching on the area of evaporation furnished by the surface of the lake. This, however, is but a small part of the erosion and deposition which has

taken place. About 3000 square miles of territory drains into the Jordan between Lake Galilee and the Dead Sea. The gradient of the streams carrying off this drainage is exceptionally steep, descending as they all do from a height of 3000 or 4000 feet. Now it is estimated from a wide range of observation that erosion is taking place over the continents as a whole at a rate which removes one foot of soil in about 3000 years from the whole continental surface, and deposits the same in the seas or lakes into which the streams of running water empty. The River Po has such a steep gradient that it removes one foot of soil from its whole drainage basin and deposits it in the head of the Adriatic Sea once in 700 years. We shall be perfectly safe in supposing that the *débris* brought into the Jordan below Lake Galilee, and carried by the river into the head of the Dead Sea, represents one foot from the whole drainage basin in 2000 years. And this, notwithstanding the comparatively small rainfall over the region.

For, even though small on the average, the rainfall frequently comes in the shape of cloud bursts which are the most effective of all agencies in erosive activity. It is this fact which gives such point and emphasis to Christ's figure of the insecurity of the house built on the sand. The little deltas of sand and gravel deposited at the foot of every mountain stream are sure to be washed away by succeeding floods, to give place to others in slightly different locations. All the wadies entering the Arabah bear witness to this. The bed of the stream formed by the junction of Wady Zuweira and Muhauwât, just north of Jebel Usdum, is fully half a mile wide, and is covered with pebbles and boulders a foot or more in diameter which have been rolled along some distance over a level bottom. Any one who has been in the Wady Kerak during a thunder storm such as Lynch describes can realize better than any one else how active these dry wadies are when the rains descend, and the winds blow in all their force. I recall with great vividness a scene in Central Asia, where the annual rainfall is only four inches a year, when a storm played around a mountain twenty

miles west of us without giving us a drop. But when on the next day our railroad reached the foot of the mountain the track was covered for a long distance with *débris* several feet deep that had been washed down the day before, requiring hundreds of men to clear it away so that we could pass.

It is not, therefore, extravagant to say that one foot of soil from all over the drainage basin between Lake Galilee and the Dead Sea is brought into the Jordan and transported into the head of the lake every 2000 years. Calculation will show that at this rate one cubic mile of sediment has been dumped into the lake below Beth-Hoglah since the partition of the land in Joshua's time. This is enough to cover 25 square miles 250 feet deep. With any reasonable estimate of the depth of the upper end of the Dead Sea, therefore, it is as certain as any scientific fact can be that in the time of Joshua the lake extended as far up as Beth-Hoglah, thus supplying the conditions implied in the description of the boundaries given in the verses under consideration.

That the level of the lake must have been lower at that time than it is now, follows as a necessary consequence from the effect of the encroachment upon the area of the lake by this deposition. Every foot of encroachment upon the lake's area diminishes the area of evaporation, and the water must in consequence rise and overflow lower surrounding areas in order to reestablish the disturbed equilibrium.

Nor is the deposition at the north end of the lake the only factor to be considered. Another nearly, if not quite equal, area of drainage coming directly into it, is found in the basins of the numerous wadies bordering the remaining three sides. Even the Wady el-Jeib, the largest of those coming in from the south, though dry a portion of the year, is a raging torrent at times, and therefore a most powerful eroding and transporting agency. This and all the other wadies have extensive deltas about their mouths which have encroached on the former area of the main part of the lake.

This calculation is fully sustained by study of the actual conditions. The delta of the Jordan commences at the

"Jew's Castle," about eight miles from the Dead Sea, and the embankment of the Zôr begins to slope away in a south-westerly direction till it reaches Khurbet Kumrân ten miles distant, leaving a triangle of low land averaging fully one mile and a half in width, being, opposite the mouth of the Jordan, two miles wide. The face of the embankment separating the Zôr from the plain of the Ghôr has in several places been deeply cut into by the small wadies which come down from the western mountains, and the wash from these wadies, as well as that from the temporary streams after every shower, has considerably raised the western border of the Zôr throughout this distance. But it can be safely estimated that the original borders of the Dead Sea have here been encroached upon to the extent of ten square miles; while upon the eastern side of the Jordan Merrill says the "plain for many square miles north of the sea is like ashes in which we often sank over shoe;" and he was compelled to walk for some hours along the shore and then north to reach his horses, which evidently had been coming over the harder and more elevated surface of the Ghôr. Speaking of this region Merrill remarks that "since so vast an amount of soil and other material is carried down by the Jordan every year it seems that a process of filling-in must be going on in some part of the sea, either at the bottom or on the shores where this material is carried by the current of the river" (*East of the Jordan*, pp. 223, 224).

This remark of Merrill's raises a question which it is important to consider here, namely, how can a river build up a delta higher than its own level? That this is actually the case is easily seen on examining the deltas of almost any stream. The coarser material brought down by the swift current is deposited soon after striking the plain or still water, building up in the water the bars which cause so much trouble in obstructing such harbors as are near the mouths of rivers. As an illustration of this it is sufficient to cite the case of Ephesus, whose harbor has been completely destroyed by the sediment which has filled the lower portion of the Meander. In the case of the Jordan as it enters the

Dead Sea a powerful influence affecting the deposition exists in the variation in the level of the sea, which amounts to ten or fifteen feet annually and still more at longer intervals. During low water, therefore, an extensive beach is exposed to the winds which transport an indefinite amount of material to the slightly higher levels, and thus produce the exact condition of things which we now find over this area.

But the deposition at the mouth of the Jordan is less than half of the whole. The sediment brought down by the streams upon the two sides of the sea and at the south end needs to be studied in detail to complete the impression. From Khurbet Kumrân, where the upper level of the Ghôr ends, to Râs Feshkah there is a triangular shore deposit which averages one half mile in width and two miles in length, which is a continuation of the deposits in the Zôr. From Râs Feshkah, which rises abruptly from the water's edge, to Râs Mersid, a distance of fifteen miles, the shore is again bordered by sand and gravel deposits brought down by the numerous wadies descending from the Judean mountains. According to De Sauley the delta at the mouth of Wady en Nâr, which comes down from Jerusalem, is something over half a mile both in depth and in width, and abounds in "fragments of rocks or bowlders swept along by the force of the torrent in its periodical overflows" (*The Dead Sea and Bible Lands*, Philadelphia, 1854, i. pp. 137, 138). At the mouth of another wady De Sauley describes what geologists call a "cone of dejection," where "the gravel washed down from the heights is heaped up to the extent of nearly two hundred and fifty yards" (*ibid.* p. 144). Throughout this distance the shore averages one half mile in width and is fully one mile wide opposite Wady Derajeh and Wady Hûsâhah.

The Plain of Engedi is described by the Palestine Exploration Fund as "about half a mile broad and a mile in length." This is material brought down by Wady Sideir and Wady el-Areijeh. Between Engedi and Sebbe (Masada), a distance of ten miles, the mountain cliffs retreat until they are fully two miles from the shore. Across this

numerous wadies course their way, bringing down an immense amount of *débris*, and depositing it as deltas at the water's edge, one of which is described by De Sauley as having a breadth of 500 yards, and another as indefinitely larger. Lynch notes a delta five or six miles south of Sebbeh which he says extends "half a mile out" into the sea. Beyond this is the delta at the mouth of wadies Zuweirah and el-Muhauwât, which covers two or three square miles.

At the south end of the lake Wady el-Fikreh, draining an area of about 200 square miles, has brought in an immense amount of coarse sediment, which it has deposited on the west side of the Sebkah (mud flat), which was formerly a projection of the Dead Sea; while Wady el-Jeib, fed by innumerable tributaries from the mountains of Edom and draining an area of well-nigh 2000 square miles, combined with Wady Tufileh and Wady el-Khanzîreh, has encroached upon the Sebkah with coarse deposits to an extent of seven or eight square miles. Following down the east shore, Wady el-Hessi has pushed out a delta of coarse material into the eastern neck of the Sebkah, covering three or four square miles. Still farther north Wady Kerak and Wady Benî Hamîd have built up deltas which have encroached to the extent of two or three square miles upon the head of the bay lying east of the Lisân. Wady Môjib and Wady Zerka Mâ'ain have built up less pronounced deltas because of the greater depth of the water on the east side, but even so they are by no means inconsiderable.

Putting these separate items all together, it would appear that the supposition that the area of the Dead Sea had been diminished by the deposits of its numerous tributaries to the extent of twenty-five or even forty square miles is below rather than above the probable amount.

Concerning the tongue at the south end of the Dead Sea, it is impossible to speak with the same definiteness that we can concerning that at the north end. But the projection of the mud flat (Sebkah) at the south end would seem to indicate the former extension of the bay in that direction, the central channel of which has been filled up by the finer

sediment carried into it by the numerous wadies which have deposited the immense deltas of coarser material constituting the Ghôr el-Feifeh and Ghôr es-Saffieh now covered with rank vegetation.

At any rate there is no question that the limits of the lake have been circumscribed greatly at both the north and the south ends, as well as at numerous points where wadies come in from the highlands on either side, provided that the forces of nature have operated continuously for the last 4000 years as they are operating now. These present forces would bring in sediment enough to cover 25 square miles 500 feet deep with sediment. An encroachment of 25 square miles on the area of the lake would cause it to rise any amount until the proper evaporating area to maintain the equilibrium was exposed to the sun. We may believe, therefore, on the best of geological evidence, that the larger part of the lagoon south of the peninsula of the Lisân was, in Abraham's time, dry land and watered sufficiently to make it "like the garden of the Lord, like the land of Egypt, as thou goest unto Zoar" (Gen. 13 10), as the plain of Sodom and Gomorrah is said to have been. This will, therefore, reopen the question about the situation of the cities of the Plain, and revive interest in the tradition that the site of the cities that were destroyed now lies submerged by the waters of the lagoon at the south end of the Dead Sea.

In conclusion, however, it is necessary to add the cautionary remark, that these, like all geological calculations, are subject to modification if there is evidence of changes having taken place in the activity of the forces involved in the problem. If the rainfall over the Jordan Valley was greater in the time of Joshua than it is now, that would compel us to assume a greater area for the Dead Sea than it now has, and, so far, vitiate the foregoing conclusions. But of this we do not have sufficient definite evidence to make it a base of calculation. Periodical variations in the level of the Dead Sea have been noted in recent times, but they do not seem to have any connection with the general conditions with which this paper has been dealing. They are too

rapid to be the effect of those general causes. Reference has already been made to the submerged trees around the border which indicate that during the last forty years there has been a rise in the water of eight or ten feet. But in 1818, when Irby and Mangles visited the region, there was a ford in use leading from the Lisân to the western side of the lake. It is not now practicable to use this ford. When Professor Hull and his party visited the south end of the lake in January, 1884, they traversed the shore east of Jebel Usdum along a sandy beach 100 feet wide which was five feet above the water level. In January, 1901, when my party visited it, it was impossible to proceed along the base of Jebel Usdum, on account of the water two or three feet deep which was washing the base of the Salt Mountain, while five years later Professor Schmidt reports that he slept on this beach.

Evidently these minor variations are connected with brief variations in the climatic conditions which need not affect the general results. But it would be well to know from just which one of the varying levels of the water the calculations are made which fixes the depression of the Dead Sea at 1292 feet below the Mediterranean Sea.